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Contents

	page
Grass—Temporary or Permanent *J. R. Garstang*	323
Worm Problems in Young Beef Cattle *S. C. Meadowcroft and A. H. Yule*	329
'EMLA' Fruit Trees *A. I. Campbell*	334
Group Operation of Machinery and Labour *Warner K. Hall*	341
Drainage on Weald Clay *W. Addison*	348
Beef Production in Italy *A. J. Chalmers*	354
Conservation: An Estate Walk in Surrey *J. Lewington*	359
Farming Cameo Series 5: 11. Cornwall *G. H. Hughes*	362
In brief	364
Book Reviews	366
Ministry Publications	367
Agricultural Chemicals Approval Scheme	368

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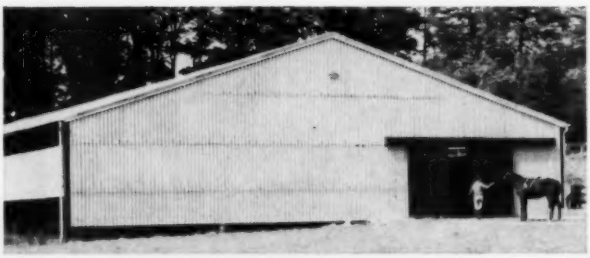

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Young stock grazing the ley deterioration trial

Leys figure frequently in grassland management. A.D.A.S. aim to find out what is the more productive

Grass—Temporary or Permanent

J. R. Garstang

THE dual position of the ley in British agriculture covers both the arable and livestock areas of farming. In the arable sector it is considered a regenerative break within an intensive crop production system, whilst in livestock production areas it is frequently considered a regenerative break in the maintenance of grassland productivity.

In the arable systems a drop in productivity and degeneration of sward type are of importance in long-term leys; it is the increased production from

the crops following a ley that are of more concern. In this field the long-term Ley Fertility experiment on the Experimental Husbandry Farms is concerned with many factors affecting production.

In livestock production, where the ley is used to improve poor grazings in a permanent pasture system or provide either the bulk of conservation in a permanent system or the main acreage of grazing and conservation on a rotational ploughing-reseeding cycle, its maintenance of productivity and output is the ley's most important function. As a livestock farm in the Pennine area with a 60-inch rainfall and steepish slopes, Great House Experimental Husbandry Farm might be expected to be placed fairly and squarely in the first of these categories of ley usage systems. Work done over several years has been aimed at ascertaining whether a system based on temporary or permanent grass was the more productive and profitable for this area.

Permanent v. temporary

The completed findings of this work* cover a sequence of trials done on plots, paddocks and ultimately on a farm scale. In terms of response to fertilizer there is little to choose between leys and permanent grass in reasonable condition. On the farm scale comparison the output of the ley was marginally higher, but as Table 1 shows, this marginally greater productivity was just outweighed by the reseeding costs.

Table 1

Comparison of two 40-acre farms

	Permanent	Temporary
Milk yield (gal/cow)	652	700
Output (£/ac)	61·6	65·8
Variable costs (£/ac)	22·5	27·6
Margin (£/ac)	39·1	38·2

*The work is discussed in detail by Bastiman and Mudd in 'A farm scale comparison of permanent and temporary grass': *Experimental Husbandry 20*. H.M.S.O. London (price 65p, by post 70½p).

From this arise the questions: 'How long is the temporary type output level maintained, when does the sward composition and yield change to a permanent type, and can grass be managed to remain a temporary type'? Perhaps the last question is better paraphrased as: 'Can sown grass be managed to become good permanent grass'?

Ley deterioration

Many grassland farmers, especially those farming on good fattening pastures, would not doubt their ability to produce good permanent grass derived from a ley. Soil and climate, however, do have a large effect on the production of a good permanent sward, and latterly the economic climate has had an even greater influence. The demand for increased output from fixed acreages leads to increased nitrogen use, which in turn leads to open swards. Intensive grazing systems for dairy cattle are aimed at the continual presentation of herbage in sufficient amounts to avoid loss of milk production.

As grass growth varies whilst herd appetite remains relatively constant,

inevitably this leads to undergrazing at certain times of the year, rejection of large areas in bad weather and rejection of areas around dung pats. Couple these with the effects of poaching and treading and it can be seen that swards under intensive grazing systems encounter quite considerable pressure to become anything other than good permanent grass.

Cattle grazing round dung deposits

Sward composition changes

With this in mind a trial was set up in the spring of 1966 to study the short and long-term changes in sward composition and productivity over the transition period from a long ley to permanent pasture. An all grazing system was compared with a hay and aftermath grazed system at annual nitrogen dressings of 80, 160 and 240 units per acre.

Of the two systems over the years, excluding the establishment year, the mean yields of cut material at the three levels of N shows a significantly higher yield (69·6 cwt DM per acre) for a hay crop with aftermaths grazed as against the all grazed ley (58·8 cwt DM per acre). This is no doubt a reflection of greater production during the peak growing period in letting the hay crop grow, whilst the grazed crop is defoliated when the growing conditions are at their best. Were the grazing season at Great House longer, it is doubtful whether the percentage difference would be quite as marked.

Over the years the yield fluctuations show that the highest output is associated with the second year's production from the ley. Thereafter the yields drop slightly, but fluctuations due to seasonal differences mask any

definite yield trends due to alteration of sward type. The percentages over this period of non-sown species that invaded the original sward of perennial ryegrass, meadow fescue and timothy are also shown in Table 2.

Table 2

Dry matter yields and non-sown species in the ley, 1966-71

	1966	1967	1968	1969	1970	1971
Total DM yields (cwt per acre):						
Grazed	32·9	62·9	53·9	53·4	55·6	68·6
Hay and grazed		76·9	70·3	57·9	63·6	79·6
Non-sown species (%)	7	12	12	35	36	26

Any effects of conserving for hay on sward composition appear to have been minimal and show no definite differences between the two management regimes. The three grazings which are taken from the aftermaths no doubt tend to cover any effects caused by the conservation at the start of the season.

It can be seen that since 1966 yields peaked 'as a ley' in 1967 and again in 1971 at an even higher level. Although the sward composition changed in 1971 more towards the sown species than in the previous two years, it still contained over twice as many non-sown species as in 1967.

The immediate question that arises is whether by 1971 the ley had become a permanent type sward, or were the higher number of non-sown species just a partial degeneration of the sward? By 1971 permanent grass plots set up at the same date in 1966 had changed considerably from their original composition. Thus it is apparent that the composition of both types of sward was in a continual state of flux, and the question of their description relatively unimportant.

Does the percentage of sown species remaining in 1971 reflect the degree of 'ley-type' components remaining? Are the sown species remaining the actual plants sown, along with vegetative growth, or are they a fairly narrow band of species from the originally sown population that have developed because they are more suited to growth under conditions at Great House? Over the five complete years since sowing, selection for suitable plants could have occurred within the population, and in 1971 favourable conditions allowed these plants to yield their potential. Further evidence is necessary, however, and continued application of the management practices and recording of the sward composition will enable further changes to be observed.

Continued application of high levels of nitrogen to permanent grass plots cut by machine over ten years has resulted in the ryegrass in some swards increasing from 16 per cent to over 90 per cent. This trend towards ley-type sown species by using high nitrogen also contributes to blurring the line between leys and permanent grass. Such permanent swards produced by high nitrogen use although of good composition do tend to be rather open, and when the defoliation is other than regular and mechanical, i.e., grazing or grazing with conservation cuts, the incursion of weeds and the consequent lowering of production tends to produce the more typical permanent sward. If the defoliation is by grazing, then the accompanying problem of rejection is often the main contributing factor in the deterioration of the ley.

Rejection

Not only is the productivity of swards receiving high nitrogen reduced by the post-grazing incursion of weeds *per se*, but the output of the sward at later grazings is reduced by the rejection of herbage round fouled areas. In field observations at Great House the rejection levels in three separate seasons have peaked between the fourth and sixth grazings at amounts of 44 per cent, 31 per cent and 14 per cent. Although this area exceeds the area actually covered by dung, the amount by which it exceeds the dung area varies with such factors as grazing pressure, rate of dung breakdown and weather. Nevertheless it is the total area of dung and rejected herbage that governs the potential amount of sward degeneration, and it is the subsequent herd grazing management that dictates whether this potential degeneration occurs. Also there are other uncontrollable factors that, despite sensible grazing and herd movement, can affect the degeneration; moist ground conditions lead to treading damage and poor regrowth conditions allow the development of weed species, especially in swards opened up by liberal nitrogen usage.

Prevention of sward degeneration under intensive grazing conditions is often attempted by either topping or harrowing grazed land—both simple and rapid field operations. The efficacy of these two techniques was investigated at Great House on adjacent paddocks of similar topography and sward type. One paddock was topped after each grazing, whilst the other was not topped at all. The effect of topping on the percentage of herbage rejected is shown in Table 3.

Table 3

Effect of topping and harrowing on percentage herbage rejection

Grazing No.	Topped	Untopped	Harrowed	Unharrowed
1	0	0	0	0
2	30	29	17	17
3	30	36	17	12
4	NA	NA	27	40
5	46	63	25	14
6	19	21	16	18

It would appear from these results that topping has a place in reducing the mid-season rejection levels. On both the control and topped plots, however, this peak dropped to 20 per cent at the next grazing. So an apparently bad mid-season rejection problem appears to remedy itself.

The results from harrowing on adjacent paddocks (also shown in Table 3) gave similar results. Here again the mid-season peak was reduced, but dropped naturally to a low-level on the unharrowed paddock during the later grazing.

Renovation

High productivity, as in any industrial system, requires adept management, and grassland farming is no exception. From the topics already discussed it is clear that the ley has a vital role in high output grassland. It is, however, very difficult to tell precisely when a 'ley-type' sward becomes more akin to

the permanent swards of the farm; primarily because no one feature can be definitive of what a ley is. It is also far from easy to manage a ley over this transitionary period so that the resulting permanent sward is of a good productive type. In the experimental ley plots at Great House, comparing the average yields of 1967 and 1971, this may have been achieved, but experimental results cannot be transferred directly on to any farm simply by enlarging the scale of application of the experimental technique. More animals destroy more sward at more gateways. Larger paddocks tend to contain variable swards and are therefore grazed less evenly by the stock.

Despite these difficulties the role of the ley as a renovation method in a permanent grass farming system will no doubt survive, if only because the alternatives also have problems. The continual use of correct fertilizer levels to evolve a good sward from permanent grass needs several years and, although possible on cut plots, field scale application is a good deal more difficult. The use of reseeding by means of a ley is a faster proposition, and in the year after establishment a high yielding crop for conservation is an extra bonus. Thereafter one has to contend with the lower durability of the 'ley-type' sward until a denser sward is obtained which is more resistant to poaching.

Superficial treatment of permanent pasture at Great House, with harrows along with fertilizer and reseeding, did not increase the productivity of the field over and above the original permanent pasture. Complete cultivation and reseeding appeared to be needed for good sward development.

So if turnover, in terms of fertilizer inputs and animal product outputs, is to be maintained on farms of predominantly permanent grass, sooner or later a ley will be needed to keep up production levels. Once established, correct stocking rates at a suitable grazing stage avoid excessive waste of herbage or overgrazing, both of which can lead to sward deterioration. Drainage should be well maintained on land intended for reseeding, as even on sound land poaching is one of the main weaknesses of the ley. Along with these management practices the output must be maintained at a level that justifies the cost of reseeding. It is these intensive farming pressures which require the use of a ley rather than slower more continuous techniques that are the same pressures making the change from ley to productive permanent grass less straightforward.

J. R. Garstang, B.Sc., is an adviser on the staff of Great House Experimental Husbandry Farm, Rossendale, Lancs.

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Advice on other, less hazardous, methods of bulb dipping may be obtained from the Ministry's Agricultural Development and Advisory Service.

Progeny Test. Hereford X Friesian steers at grass

EXPERIMENTAL HUSBANDRY FARMS

Worm Problems in Young Beef Cattle

S. C. Meadowcroft **A. H. Yule**

SINCE 1960 considerable efforts have been made on M.A.F.F. Experimental Husbandry Farms and elsewhere to develop more profitable systems of beef production from grass. These have resulted in new methods being evolved which have placed beef in a competitive position with other grass-using enterprises, and today many well-managed 18-month beef units attain a gross margin per acre within the £50–100 range. However, this sort of result is likely to be realized only where young cattle are kept intensively. This means a year-round stocking rate of around 1½ beasts per acre for calves born in the previous autumn and where paddock grazing is practised, the stocking density in a paddock may be as high as twenty beasts per acre. Experience has shown that young beef cattle react less favourably than dairy cows to such overcrowding at grass. The result, frequently, is an unsatisfactory level of liveweight gain from mid-season onwards, with the

cattle under target weight at yarding. Consequently, their bulk feed must be liberally supplemented by relatively expensive cereals in the following winter if the lost ground is to be regained.

Reconciliation of good individual liveweight gains with the high levels of stocking rate forced by economic factors is the big challenge which faces the producer of beef from grass. By the commitment of perhaps £200 of working capital per acre and considerable management expertise, he can match the required numbers of good quality beef stock with an ample growth of herbage. But the financial success of the enterprise can even then be jeopardized by the presence of stomach worms which may impose a limit on the summer progress of the cattle.

Understanding the infection

Studies carried out at the Central Veterinary Laboratory, Weybridge, during the 1960s have led to a better understanding of the epidemiology of gastro intestinal nematode infection, and to new suggestions for its control. It has been shown that the time taken for worm eggs dropped in the faeces to develop into infective larvae on the pasture may be four months in the early spring and only two weeks in mid-summer, with the result that a large increase, or 'explosion', in the infestation occurs in July. The control measures proposed by J. F. Michel of the Central Veterinary Laboratory are, therefore, based on removing the cattle from the source of this heavy infestation in mid-July and grazing them instead on parasitically 'clean' aftermath grass. In his trials at Weybridge in 1964–67, this practice, coupled with an anthelmintic dose on the date of removal, resulted in liveweight gains over the season of up to 150 lb per animal more than those of cattle not removed from the worm-infested grass. These studies led him to say in *Agriculture*, June 1967, 'there are grounds for hoping that stomach worm infection in calves, which is estimated to cause an annual loss of about 2 million pounds sterling, may prove to be readily controllable.'

E.H.F. trials

During 1967-70, the Weybridge technique was tested at two Experimental Husbandry Farms in the Midlands, Drayton and Rosemaund, and at two in eastern England, Gleadthorpe and High Mowthorpe. A total of 398 Friesian and Hereford x Friesian steers were involved, those at Drayton, Rosemaund and High Mowthorpe being autumn-born cattle turned out at 400–500 lb in the spring and those at Gleadthorpe being spring born calves of 200 lb average weight at turnout.

Four methods of management were compared at each farm:

1. Same pasture. Cattle given access to the same pasture throughout the summer. No anthelmintic dosing.
2. Same pasture plus anthelmintic. As group 1, but cattle dosed in mid-July with thiabendazole at 200 mg active ingredient per Kg body weight.
3. Aftermath. Cattle allowed to graze fresh aftermath only from mid-July. No anthelmintic dosing.
4. Aftermath plus anthelmintic. As group 3, but cattle dosed as group 2.

In each year at all centres the presence of an initial worm infestation on the herbage was confirmed. All the cattle were paddock grazed together until mid-July at around four beasts per acre (7 to 10 per acre for the smaller calves at Gleadthorpe). Four similar treatment groups were then formed and grazed separately for the remainder of the season, with groups 3 and 4 on aftermath grass only and groups 1 and 2 having access to pasture grazed throughout the spring. The aim was to provide an adequate growth of short leafy grass at all times for all the cattle. The records kept included liveweights, levels of infestation of herbage samples with infective larvae, faecal worm egg counts and full health details.

Performance at grass

The performance of the animals at grass at the four trial centres is given in Tables 1 and 2. For each centre the results are the mean of three year's trials.

Table 1

Mean liveweight at turnout and at yarding (lb)

Treatment	Rosemaund		Drayton		High Mowthorpe		Gleadthorpe	
	Turnout	Yarding	Turnout	Yarding	Turnout	Yarding	Turnout	Yarding
Same pasture	458	687	372	630	493	748	198	394
Same pasture + anthelmintic	458	694	373	633	495	728	196	385
Aftermath	458	719	374	665	498	699	197	393
Aftermath + anthelmintic	460	736	373	661	494	714	201	404

Table 2

Mean daily liveweight gain from mid-July to yarding (lb)

Treatment	Rosemaund	Drayton	High Mowthorpe	Gleadthorpe
Same pasture	1·41	1·57	1·77	1·83
Same pasture + anthelmintic	1·55	1·63	1·71	1·74
Aftermath	1·93	1·99	1·38	1·89
Aftermath + anthelmintic	2·08	2·04	1·53	1·96

At Rosemaund and Drayton the groups of cattle which were drenched and moved in mid-season on to aftermath gave a definite response in liveweight gain. By following the recommendation of drenching and moving on to a clean aftermath in mid-July, an advantage of about ½lb liveweight gain per head per day was obtained, amounting to 30–50 lb per beast in the second half of the season. Even by moving away from the source of infection and not drenching, gains were improved almost as much and this gives support to J. F. Michel's prediction of the pattern of worm infestation on the pasture.

To make sure the response was not largely due to pasture change and palatability, further groups of animals at Rosemaund were moved at the same time to land which had been grazed in the first half of the season by

cattle at the same stocking rate but which had been kept worm free by a special experimental technique. It was, therefore, soiled by dung and urine but was virtually free of infective parasitic larvae; here also a similar advantage of approximately ½ lb per head per day in liveweight gain resulted.

Where the stock was drenched but remained *in situ* grazing the same paddocks throughout the season, little response was measured. It seems from the supporting evidence of faecal samples and larval sweeps that under these circumstances a single drench is not likely to be of any lasting effectiveness and that re-infection of the animal occurs fairly quickly.

At High Mowthorpe there has been no advantage in moving to fresh aftermath in July, but due to shortage of keep at this farm there was provision of additional aftermath grazing for cattle which continued to have access to the spring grazed paddocks. It seems possible that the provision of some grass free of infective larvae may have given a dilution effect and helped to keep any worm burden at a reasonably low level. It may be that at this farm the amount of grass on offer at a particular time due to seasonal factors was more critical than the level of worm infestation.

At Gleadthorpe, with the younger calves, there has been little advantage in grazing aftermaths in the second half of the season. However, levels of worm infestation were low, the cattle had supplementary feed at grass and the grazing season was relatively short. All these factors could have contributed to the smallness of the response.

In general the risk of heavy worm infestation seems less in the eastern half of the country. This may be reflected in the differences in response to the treatments between Rosemaund and Drayton on the one hand and Gleadthorpe and High Mowthorpe on the other.

The health of the animals at all centres was good and clinical helminthiasis was not seen. Any minor troubles which occurred—foul in the foot, eye infections and bloat—could not be associated with the experimental treatments.

Financial interpretation

To place a financial interpretation on these results, the cattle at Rosemaund were professionally valued at turnout and again at yarding on the basis of the prices which were currently ruling in the store markets.

Table 3

Mean valuation (subsidy not drawn) at turnout and yarding, Rosemaund 1968-70 (£)

Treatment	1968		1969		1970		Increase in value
	Turnout	Yarding	Turnout	Yarding	Turnout	Yarding	Turnout to Yarding
Same pasture	47	65	54	76	56	76	20
Same pasture + anthelmintic	47	70	57	77	57	77	21
Aftermath	46	71	53	76	54	83	26
Aftermath + anthelmintic	47	72	54	79	57	84	26

Table 3 shows that the better liveweight gains resulting from the technique of moving to clean aftermath grazing in July were reflected in an improved valuation by the end of the grazing season of £5 per head. With higher prices for store cattle this figure would be exceeded.

Practical implications

The evidence of the life history studies of the more important stomach worms *Ostertagia ostertagi* and *Cooperia oncophora* suggests that 15th July is an important date in achieving the most effective control of the parasites and the best animal performance. As the development of the parasite cannot be influenced, this date of movement to clean pasture has to be met by variations in management. However, its adoption undoubtedly brings problems both in the management of the grassland and of the grazing cattle.

Taking the grassland first, semi-intensive beef systems frequently involve the grazing of a limited area in the spring months with the remaining acreage being closed up for a silage cut. To safeguard the digestibility of the conserved material, grass should be cut at around ear emergence; this means between mid-May and the second week of June for the rye grasses and other species commonly grown. There is, therefore, an awkward period of 5–8 weeks between defoliation and the date when the aftermath is required for grazing, and in this time the growth may have become too long to be in the ideal grazing condition. Haymaking with a June cutting date may provide an alternative, but hay aftermaths can be less reliable. A further problem is the use of the spring grazed pasture from July onwards and where young beef cattle are the only stock enterprise it is difficult to devise methods of management that avoid the risk of worm infection.

A possible alternative to conservation would be the use of another class of stock where the main parasites would not be interchangeable. Sheep may be used in a changeover system with the cattle, but experience at Rosemaund has shown that the two enterprises are difficult to intergrate with a tendency to complicate the management problems in order to meet the optimum needs of both types of stock.

The main difficulty in managing the cattle for a mid-July move is that they may be ready for a change of grazing before this date. Autumn born calves are often grazed at 4–5 per acre from turnout in order to achieve the desired intensity of stocking and to conserve enough grass for winter keep. If turnout is in April the cattle are expected to graze at this density for some three months, and experience suggests that this can be too long. For these reasons some modification of the date of the move to fresh grass may have to be accepted under certain circumstances because to sacrifice production and the well being of the stock in early July would not be a sensible policy.

From the results available, the system as followed in the trials appeared to ensure a liveweight gain of 2 lb per head per day from mid-season to yarding at three of the four centres. This was achieved in circumstances where a recognized worm problem was not obvious and where levels of herbage worm infestation were not high. As a means of controlling the principal stomach worms in young cattle the system appears to be sound and where worms are a problem it offers considerable advantages. Even where worms are not recognized as a problem it can afford insurance of good performance in the second half of the grazing season.

S. C. Meadowcroft, B.Sc., and **A. H. Yule, B.Sc.,** are both on the staff of Rosemaund E.H.F., Preston Wynne, Hereford.

Better crops from healthier trees are in prospect with virus tested

'EMLA' Fruit Trees

A. I. Campbell

VEGETATIVE propagation is a cheap and reliable way of establishing a wide range of crops plants, including tree fruits. But there is the constant danger of perpetuating virus infections which may cause deterioration of crop performance and, for many such plants, schemes have been introduced to select or produce and maintain virus-tested or virus-free clones. These have often enabled crops to be grown which otherwise might have been eliminated or drastically reduced in importance, and some schemes have radically changed the propagation and cultural practices used; for instance, that for potatoes introduced in 1918 primarily for wart disease but later amended to include virus diseases; and that for strawberries introduced in 1931.

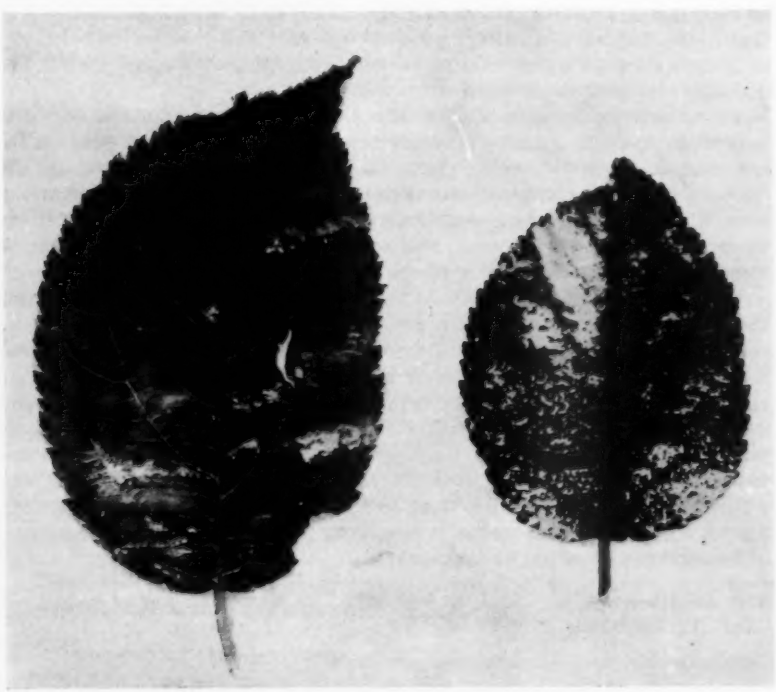


Fig. 1. Apple leaves showing mosaic virus symptoms
Left: Mild strain. Right: Severe strain

First fruit-tree scheme

With most of the crops where selection schemes have been introduced, the viruses were readily identifiable; they usually spread rapidly within the crop and the damage caused was obvious. In fruit trees, where the presence of viruses was not recognized until the mid-1940s, the need for virus-tested material was less apparent. When the mother tree scheme for fruit trees was introduced by East Malling Research Station in 1953, the improved growth and cropping of many varieties fully justified the considerable testing and selection that had taken place.

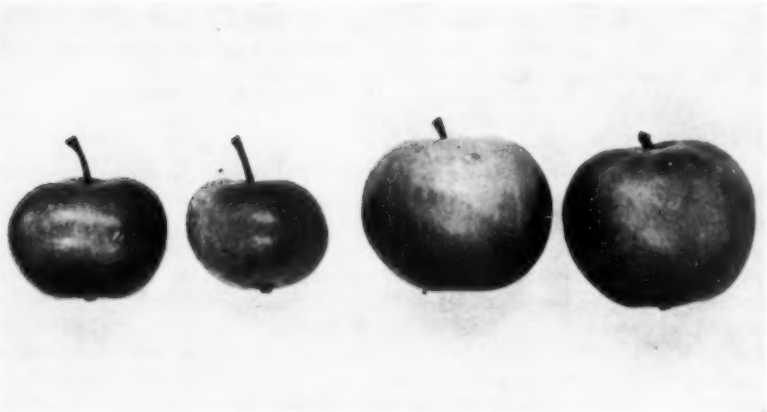


Fig. 2. Merton Worcester Apple
Left: Two apples from a tree infected with chat fruit virus
Right: Two apples from a healthy tree

It was soon recognized, however, that although the improved selections were better than many of the clones in commercial use they were still not free from all viruses. Most of the apples, for example, although free of mosaic (Fig. 1), rubbery wood, chat fruit (Fig. 2), star crack and other recognizable viruses, were infected with several latent viruses. Similarly many of the cherry and pear varieties were often infected with viruses which, in most, caused no obvious symptoms.

Another shortcoming with the early scheme was the absence of any check on the material after it had left the Research Station. If faulty cultural practices were used, the improved material could become re-infected within a very short time. Usually the healthy clones became contaminated by graft contact with infected material or, less commonly, by root grafting, infected pollen, insects or eelworm virus vectors. The numerous health descriptions in common use such as 'virus-tested', 'heat-treated', 'virus free', 'special stock' and 'mother tree material' tended to confuse research workers, advisers and growers alike. Often the terms did not specify which virus tests had been carried out or even whether they had been successful. In addition, different testing and identification procedures were in use at the different research stations.

'EMLA' Scheme

In these circumstances, two stations working on tree fruits, East Malling and Long Ashton, decided to standardize their testing procedure and to make available to the growers in this country one selection of each variety. Each selection is known as the 'EMLA' clone, a name derived from the initials of the two stations, and is the best material available of each fruit variety. The EMLA clones must be free of all known viruses and of a good pomological standard. The scheme is designed to give the nurseryman and grower a guarantee that the scion or rootstock has reached an approved standard. If, in the course of time, any further improvements are made either in the health of the material or in the pomological features, a new clone will be introduced and the older clone withdrawn. In this way it should be possible to maintain or to improve the scion and rootstock material as necessary and to add new varieties to the scheme when required.

Orchard trials

To examine the performance of the improved selections, numerous trials have been planted at centres in various parts of the country and in many of these the EMLA clones have been compared with virus infected trees. In most instances freedom from virus has increased tree growth, given greater uniformity and improved cropping. The trees have also cropped earlier and the fruit has frequently been larger. A good example of the results obtained from trials with apple is the performance of 8-year-old Bramley's Seedling on MM. 106, MM. 111 and MM. 104 rootstocks. The EMLA trees are 3 cm. larger in trunk girth. On MM. 106 and MM. 104 they have yielded on average during each of the last three years (1969–1971) over a ton per acre more than the infected trees. The trees on MM. 111 rootstock, although similar, have not shown such large differences, indicating that the virus effect on the rootstock can also be important.

The growth and cropping results from 5-year-old EMLA apple trees on M. IX and M. 26 rootstocks (Table 1) shows that varieties differ in their sensitivity to the viruses. Since, however, several viruses are often present in the same tree, their effects can be cumulative and the strains of the virus can have an effect on the results.

Table 1

Growth and cropping of five-year-old EMLA and virus-infected apple clones on M.IX and M.26

	Girth (cm) 1971		Crop (kg) 1970–71	
	EMLA	Infected	EMLA	Infected
Cox's Orange Pippin on M.IX	9·7	8·5	15	9
Worcester Pearmain on M.IX	10·3	9·0	7	5
Egremont Russet on M.IX	12·1	10·8	5	6
Golden Delicious on M.26	11·0	10·0	6	5
Discovery on M.26	9·6	9·6	1	1

With pears, plums and cherries some viruses can reduce growth and cropping considerably, while others show few symptoms. In a trial comparing the growth of virus infected and healthy pear trees on Quince A under different manurial treatments, the virus effects were found to have a larger effect on growth than 10 tons per acre of farmyard manure annually (Table 2).

Table 2

EMLA and vein yellow infected pears on Quince A with and without farmyard manure (planted 1967)

	Girth (cm) with F.Y.M.		Girth (cm) without F.Y.M.	
	EMLA	Infected	EMLA	Infected
Beurre Hardy	13·5	7·9	8·8	6·0
Conference	6·6	5·7	6·9	4·4
Doyenne du Comice	11·6	5·4	7·2	5·0
Williams	9·1	6·0	5·7	4·7

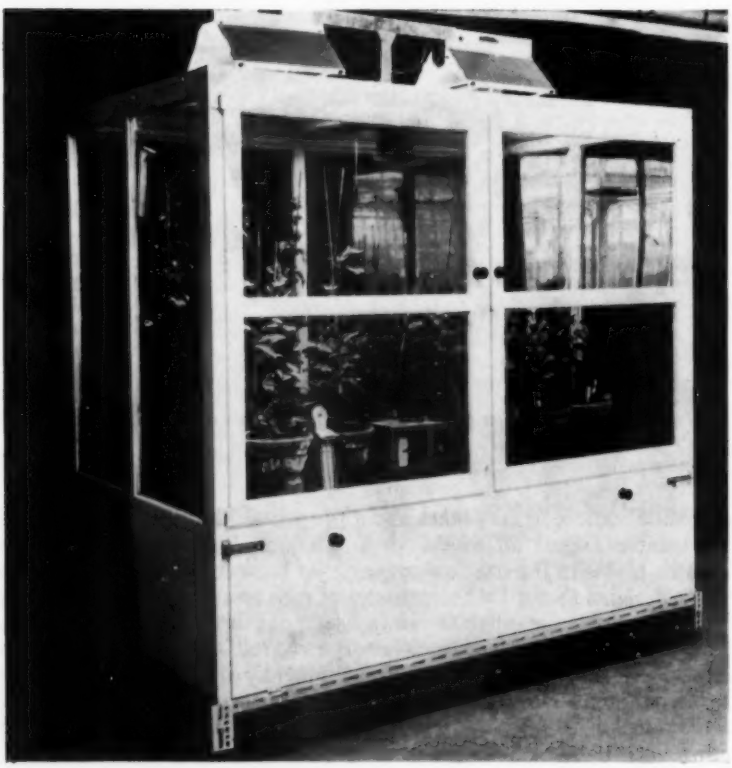


Fig. 3. Heat therapy cabinet used to inactivate fruit tree viruses

Heat treatment and virus testing

A large proportion of the 98 varieties included in the new lists (Table 3) have been obtained following heat-treatment. This procedure was necessary in many instances because no healthy clones could be found, all the trees of some varieties growing in this country being infected with viruses. The heat treatment procedure includes the preparation of trees in containers, growing infected plants at high temperatures 37°C (98°F) in a special cabinet (Fig. 3) for about four weeks and then grafting the shoot tips on to seedling rootstocks (Fig. 4). The whole process, including the very important final testing

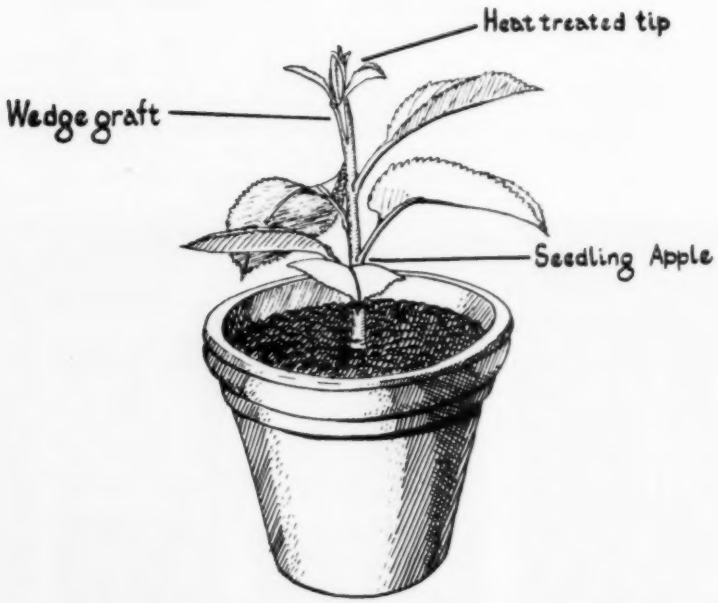


Fig. 4. Tip-grafting on an apple seedling—used to isolate the virus free shoot tip

and multiplication, usually takes about five years. This long period is necessary because almost all of the virus-testing is done on sensitive woody indicator plants in the fruit tree nursery. At present, the use of herbaceous indicator plants to test for the presence of fruit tree viruses has not reached the necessary stage of reliability and no tests of this nature are as yet known for some viruses. If and when satisfactory virus tests on herbaceous indicator plants are reliable, the long delay in the present procedure may be reduced.

Varieties are included in the EMLA list when they have been tested on an agreed range of virus indicator plants and have been shown to be free of all known virus infections. The number of test plants varies with each kind of fruit tree and for apples the list includes:

Variety	*Test for*
Lord Lambourne	mosaic, rubbery wood and chat fruit
Spy 227	epinasty and decline
R 12740	chlorotic leaf spot
Virginia Crab	stem pitting and stem grooving
Malus platycarpa	scaly bark and chlorotic leaf spot
Cox's Orange Pippin	star crack

Most of the tests take three years to complete but with chat fruit the test alone may take as long as five years to be sure that no infection is present.

Table 3

Varieties available as EMLA source material on 31st December 1971
(Those eligible for special stock certification are marked with an asterisk)

APPLES

Ashmead's Kernel
*Beauty of Bath
Blenheim Orange
*Bramley's Seedling
Cheddar Cross
*Cox's Orange Pippin
*Crispin (=Mutsu)
*Discovery
*Egremont Russet
Emneth Early
Epicure
Exeter Cross
George Cave
(Red Sport)
*Golden Delicious
Golden Delicious
'Starkspur' (Spur-type)
*Grenadier
Holstein
Howgate Wonder
Idared
*Ingrid Marie
*James Grieve
Jonathan
Kidd's Orange Red
*Laxton's Fortune
Laxton's 'Fisher Fortune'
(Red Sport)
*Laxton's Superb
*Lord Lambourne
Lady Lambourne
(Red Sport)
McIntosh Red
Merton Beauty
Merton Joy
Merton Prolific
*Merton Worcester
*Miller's Seedling
(Red Sport)
Newton Wonder
Ribson Pippin
Rosemary Russet
St. Cecilia
*Spartan
Stark's Earliest
*Tydeman's Early
*Tydeman's Late Orange
Winston
*Worcester Pearmain

PEARS

*Beurre Hardy
Bristol Cross
*Conference
*Doyenne du Comice
*Glou Morceau
Gorham
Josephine de Malines
*Merton Pride
*Nouveau Poiteau
Onward
*Packham's Triumph
*William's Bon Chretien
William's B.C.
(Compatible)

PLUMS

Anna Spath
Ariel
*Cambridge Gage
*Czar
Early Laxton
Marjorie's Seedling
Ontario
Oullin's Golden Gage
*Pershore Yellow Egg
*Rivers Early Prolific
Ruth Gerstetter
Severn Cross
*Shropshire Damson
*Victoria
*Victoria 'Grove's Late
Victoria' (Sport)
*Warwickshire Drooper

CHERRIES

*Amber (Kent Bigarreau)
*Bigarreau Gaucher
*Bradbourne Black
(=Hedelgingen)
*Early Rivers
Emperor Francis
Florence
Frogmore Early
*Governor Wood
*Merton Bigarreau
Merton Bounty
*Merton Carne
*Merton Favourite
*Merton Glory
Merton Heart
Merton Late
Merton Marvel
Merton Premier
Merton Reward
*Montmorency
*Morello
*Napoleon Bigarreau
*Noir de Guben
*Roundel Heart
Schattenmorelle
*Van

Horticultural merit

In addition to freedom from virus infections, the clones have been examined for trueness to type and for satisfactory growth and cropping characteristics. The National Fruit Trials assist with these pomological considerations which are as important as freedom from viruses. It is essential that the clones selected are as good as the best known types and are characteristic of the varieties.

The selected clones are planted in special isolation plots on the Research Stations as soon as the virus tests have been completed. The plots for apple scions are at least 50 yards away from infected material and the plums 100 yards away. The soil is examined to ensure freedom from eelworms which are known vectors of fruit tree viruses, e.g., cherry leaf roll.

Rootstocks

Although difficulties have been encountered with the heat treatment of some varieties, particularly when infected with certain viruses, in general the multiplication of scion material has not been difficult. By contrast, problems of multiplication have arisen with some of the popular rootstocks. The difficulties have been mainly those of propagation where it was necessary to release large quantities of rooted plants in as short a time as possible. Rootstocks already released are: Four for apples—M.IX, M. 26, MM. 106 and MM. 111; one for pear—Quince A; one for cherry—F. 12/1; and one for plum—Myrobalan B. Other rootstocks to cover a wider range of vigour will soon become available; these are the very dwarfing M. 27 and the very vigorous M. XXV for apple, the dwarfing pear rootstock Quince C, the dwarfing St. Julien A and vigorous Brompton for plum.

Nuclear Stock Association

Clearly most nurserymen and growers do not require all of the EMLA apple, pear, plum and cherry clones that are now available (Table 3). It is, however, essential that the healthy rootstock and scion material of the important varieties reaches the orchards in an uncontaminated condition. To ensure this, a selected number of commercial varieties—nineteen apples, eight pears, eight plums and fifteen cherries—have been released through a grower organization, the Nuclear Stock Association (Tree Fruit) Limited. This material is further checked by M.A.F.F. inspectors and if it meets the stringent isolation, pedigree and management requirements it will be eligible for a Special Stock Certificate.

Guarantee of satisfaction

These various schemes provide a guarantee to fruit growers in this country which is unsurpassed in any other part of the world. Many countries are now engaged in similar programmes to improve the quality of the fruit tree material in general use. A booklet is being prepared by East Malling and Long Ashton Research Stations which should be available within the next few months. It will describe in a much greater detail the advantages to be obtained in cropping, growth and uniformity of fruit trees resulting from the use of EMLA material.

A. I. Campbell, M.Sc., Ph.D., N.D.H. (Hons.), M.I. Biol., is a principal Scientific Officer at Long Ashton Research Station.

Group Operation of Machinery and Labour

Warner K. Hall

A RECENT A.D.A.S. survey shows that in the South Eastern Region 65–70 per cent of the basic costs on farms are made up of machinery and labour costs. Of these, labour represents 40 per cent and machinery 30 per cent. A similar pattern must also exist throughout the whole of Britain. An improvement in productivity can be achieved by keeping such costs to a minimum and group operation of machinery and labour can provide a means of doing this.

A series of five articles on group operations is to be published in *Agriculture*. In this, the first, we cover development of group operation, some problems of operation and guidelines to successful operation. Subsequent articles will cover group operation for silage making, sugar beet harvesting, waste disposal by tanker and the use of a contractor as an alternative to group operation.

DEVELOPMENT OF GROUP OPERATION

In the early 1950s, the late Mr. Leslie Aylward, a Hampshire farmer, was aware of the increasing burden placed on farmers by the capital outlay needed to mechanize small and medium sized farms faced with a decreasing labour force. To enable such farms to meet the challenge he suggested a scheme which had the following elements:

1. Provision of loan capital at reasonable interest rates.
2. Repayment of loans over a fixed period and related to the life of the plant and equipment so financed.
3. Properly regulated joint ownership and management of plant and equipment.
4. Properly controlled availability of the plant and equipment on clearly defined lines in relation to the needs of each participant in the scheme.

In 1955, in conjunction with Barclays Bank Limited, the Hampshire N.F.U. and a few friends, Mr. Aylward formed the first syndicate company in Hampshire. The scheme grew from three syndicates at the end of 1955 to 293 by mid-1962 and to date it is estimated that 1,700 syndicates have been formed. Not all are still in operation, but recent information indicates that there are at least 610 existing syndicates taking advantage of present loan facilities.

The Syndicate

The basic aim of a machinery syndicate is to improve the economic efficiency of farm mechanization by facilitating joint ownership and use of machines and by providing credit to finance their purchase. It is made up of

member farmers who decide on the operational plans. The secretary, either one of the members or an accountant, is usually responsible for finance, machine inspection arrangements and also writes the minutes of meetings. The loans obtained by the Syndicate are unsecured and do not affect any credit members may have from other sources.

The Credit Company

When forming a syndicate, farmer members approach their local Credit Company. These companies are non-profit making, having no share capital and being limited by guarantee. Their affairs are conducted by unpaid directors who are leading figures in the local farming industry. The secretary is the local N.F.U. Secretary. They are responsible for publicity and advice to groups wishing to set up syndicates; they advise the bank on the technical soundness of schemes put to them, administer the loans, ensure that machines are regularly inspected and are also able to assist should any dispute arise within the syndicate.

The Federation of Syndicate Credit Companies was established in 1962 primarily to promote new syndicates and to co-ordinate those already existing. It is responsible for publicity and advice and also negotiations at national level.

Working of syndicates

The majority of Syndicates formed so far are not large. In 1971, 60 per cent of the membership was made up of groups of only two members, 27 per cent of groups having three members, and a smaller percentage of larger groups. The larger groups will, of course, be concerned with fixed plant such as grain drying and storage. The change in the Farm Improvement Scheme which enabled individual farmers to get grant on fixed buildings and plant reduced the farmer's incentive to participate in group operation for grain drying and storage.

The smaller and the larger farmers are not active machinery sharers. The small farmer tends to borrow machines and share on an unofficial basis at peak times, whereas the larger farmer can himself, in most cases, justify the purchase and operation of most machines. The large farmer is aware, however, because of his good business sense, of the financial benefits of sharing and often does so when his enterprise does not need the full capacity of a machine. Such cases may occur where a large farmer already has two combines but needs part use of a third.

The idea of sharing does not yet appear to be widespread enough to persuade many farmers that forming a further group from the original is worthwhile. A recent survey showed that 75 per cent of farmer members belong to one syndicate only, 18 per cent to two syndicates and only 5 per cent to three or more.

A very wide range of machine types are shared, most being those concerned with forage harvesting. Very few syndicates operate more than one machine; the survey indicated that 66 per cent operated one machine only, 18 per cent two and only 5 per cent three machines. No one syndicate appears to provide the whole range of its members' machinery requirements.

Work of C.C.A.H.C.

In 1967 the Government set up the Central Council for Agricultural and Horticultural Co-operation, with the functions of promoting and developing co-operation amongst producers and administering a scheme of grants. The Agricultural and Horticultural Co-operation Scheme 1967 provided for grants in connection with proposals designed to organize, promote, encourage, develop and co-ordinate co-operation in agriculture and horticulture. To qualify for aid, a production group needed a minimum membership of three and a marketing group normally of seven, each member having a separate farm business.

A new Agricultural and Horticultural Co-operation Scheme came into operation on 1st April 1971. This follows broadly the lines of the 1967 Scheme except that it does not provide for grants for working capital, prototype co-operative activities and co-operation between small producers; but it links grant on buildings and fixed equipment with the provision for individual producers under the Horticulture Improvement Scheme and the Farm Capital Grants Scheme. The removal of working capital grants precludes aid on machinery for operations as described in the previous paragraph other than any such items as may be eligible for grant under the Horticulture Improvement Scheme 1970.

In the early months of the scheme most interest in grants for working capital (the heading under which machinery was aided) came from pea harvesting groups purchasing mobile pea viners and from arable farmers switching to highly intensive forms of production. Towards the end of 1969 it was decided that capital assets such as machinery already owned by members could be taken into account in the Council's calculation of grant, provided the assets were transferred to the ownership of the co-operative. Previously only purchases of new machinery by the co-operative were grant aided. This development, supported by the Council's intensive promotional campaign, encouraged the formation of grass production groups amongst smaller farmers. Grass production groups qualified for a grant of up to 33⅓ per cent provided they complied with the following conditions:

1. Members committed acres to the group.
2. A common grassland and fertilizer policy was agreed with the local technical adviser.
3. Members shared both machinery and labour.
4. The Central Council's standard rules for silage groups were adopted and observed.
5. The proposal was shown to be economically worthwhile.

By the end of December 1970, 289 grass production groups had been formed. Two surveys carried out by A.D.A.S. Mechanization Advisers, one in Wales and one in Somerset, have demonstrated that in the majority of cases farmers in the groups are very satisfied with machines and labour and the quality of the final product. The basic guidelines laid down by the Council had been followed and have helped to contribute to the smooth operation of the programme.

SOME PROBLEMS OF SHARING

Group operation is a new concept to many farmers and there are bound to be problems associated with group formation and operation.

Finding suitable partners

Only a small percentage of farmers operating groups have found difficulty in finding partners to share and the problem is greatest on the smaller farm. Personal relationships are the main concern in machine sharing; people are probably unwilling to combine with others unless convinced they can get on well with them. It is important that a group of farmers in an area, or a farmer with an interest in sharing machines with others, can be seen to be a leader by others either in parish work or as an expert in running machines. Anybody who is a good manager of machines on his own farm should have no difficulty in finding partners or in joining with others in group operation.

Combine Harvester, ideally suited to group use of machines and labour

Machine availability

Farmers not in group operation often think that it is not possible for all members to be able to have the machines when they need them themselves. The position with small farm groups, however, is not very different from the use of the same machine on a large farm. Problems of organization and time of harvest exist, but these can be resolved by group discussion. As long as the total work-load demanded of a machine is within the capacity of the machine chosen there should be no difficulties. It is important to arrange a rota for seasonal machines and to change the order of operation every year so that each member has the opportunity of first use.

Machine maintenance

Many farmers believe that machines used by a group are not so well

maintained as those owned privately. However, the machine regulations drawn up by each group should allocate responsibility for maintenance and repair to one member and should also arrange for complex machines to be operated by only one man. When group members were asked about machine maintenance only a small percentage said they had had any trouble. Dealers buying machines from groups for part exchange purposes stated a preference for handling such machines because their condition was often better than that of machines from other sources; machines used by a group may 'appear' less well maintained but this is due entirely to their more constant use.

Loss of independence

Sharing, by its very nature, necessarily involves some loss of independence. Some farmers who have previously hired or borrowed stated that by joining their syndicates they have achieved a greater control over, and certainty of achieving, specific operations. It appears that the larger farmer is more worried about the loss of independence than the smaller because he prefers to keep more of the operation under his sole control. As far as organizing the basis of sharing is concerned, each member's contribution to the cost of the machine should be related to his estimated use of it; the basis of these contributions should be clearly stated beforehand. In active group operation there should also be a charge approaching commercial rates for all work done in excess of each member's estimate. Furthermore, after the deduction of any charges for excess work, the cost remaining should be divided in proportion to member's shares in the purchase of the machine. If the basic guidelines and rules for setting up a group and its operation are followed there are no real problems in organizing the group operation of machines.

Most of the difficulties and disadvantages advanced by non-sharers are based on fears which have little relation to fact in respect of official machinery syndicates. They are usually based on loose lending and borrowing arrangements, or on badly planned sharing schemes tried before the rules adopted by the Federation of Syndicate Companies and the Central Council were worked out. The outstanding feature of group operation of machinery is, in fact, the relative freedom from trouble with which sharing of seasonal machines such as combine harvesters, pick-up balers and grain driers is practised.

GUIDELINES TO SUCCESS

Mr. Aylward and his colleagues in the early 1950s foresaw the need to provide a set of basic rules for group operation. The following are the rules or points which must be considered by all group members before they commence operation:

1. *The proportion of the purchase price which members shall contribute.* This can be assessed by acreage, tonnage, gallonage or hourly use. It is advantageous for all members of the group to be made liable for the group's debts.
2. *The basis on which members shall contribute to running costs and other expenses.* It is desirable for the group to appoint one member as its secretary; he should keep the account books, machine maintenance records and, if necessary, a meetings minute book. The group should

ensure, if they are borrowing money, that a bank account is opened in the name of the group.

3. *The entitlement of members to use of the machine.* This, which includes, if appropriate, a rota stating the order in which members shall have a machine and the period for which each may keep it, can be decided only after general discussion by members of their acreages, soil types, crop varieties and all other factors which go into group operation. A pattern should be established for work within one year and the start of the programme rotated amongst members so that it can be seen that all get a fair share of the group operation.

4. *Who shall operate the machine.* With many machines the operating performance is more important than the machine's potential performance as it is only by good operation that full use can be made of it. Usually the best performance is obtained when one man operates the machine on all farms. This may not necessarily be so with all machines but it is important to decide who operates each machine before the group starts work.

5. *Who provides the fuel and other running materials.* It is essential to decide this point from the start. Often it is easy with regard to fuel because the machine can be filled when it leaves a member's farm. Alternatively, records could be kept of the fuel used and charges levied at the end of the season.

6. *Who provides the ancillary services.* These can be the use of a tractor or trailer or other equipment operated in conjunction with the main machine that is shared. It is important that adjustments are made to cater for the use of this equipment and these should be decided upon when group decisions are first taken.

7. *Who shall be primarily responsible for maintaining the machine.* One member of a group should be responsible for machine maintenance and to report to the group at frequent intervals. He may not carry out the work himself but the responsibility should be his to make sure it is done regularly.

8. *Who inspects the machine.* It is important for group operation that the machines are maintained in good working order and it is of value to a group to have an independent assessment of the maintenance and wear of the machine. This can be done by a nominated dealer. The group can arrange for the machine to be inspected half yearly or yearly

9. *Are any maintenance bonuses to be made to machine operators.* If there are, then it is important to fix these from the start so that all group members and machine operators know where they stand.

10. *Machine insurance.* All machines must be adequately insured for operation within the group on each other's farm.

11. *Personal insurance.* Each member must insure his employees against liability at common law whilst working away from his own farm. This is necessary so that all workers are covered by insurance when operating machines on all farms within the group.

Summary

There can be few economic constraints to sharing because, by its very nature sharing means that the unit cost of work is likely to be reduced. The capital saved can be made available for other uses and it is often this alternative use of the capital that is the greatest benefit derived from sharing. By using more up-to-date, more developed machines, members of a group benefit from increased output due to improved machine performance and timeliness.

If the guidelines for successful group operation are followed and a group is made up of partners who are able to work together, then group operation of machinery can:

1. Reduce operating costs.
2. Reduce the amount of capital invested in machinery on individual farms.
3. Make the latest equipment available to those farms.
4. Provide an adequate acreage for the larger sophisticated machines.
5. Cater for a situation of a reducing and more expensive labour force.
6. Enable a labour gang to be formed when needed.

Warner K. Hall, N.D.A., N.D.A.E., is a Mechanization Adviser with A.D.A.S. at the Wye Sub-Centre, Ashford, Kent.

★ ★ ★

Silage Effluent—A Powerful Pollutant

Silage effluent is one of the most powerful polluting agents that agriculture produces. Once it gets into a watercourse, it can cause the complete removal of oxygen and turn the living river into a dead septic system.

Preventing this obnoxious material forming during silage-making is not a simple matter during wet weather. The following table demonstrates that the drier the grass is before ensiling, the greater the reduction in effluent.

Percentage dry matter of material at ensiling	*Amount of effluent per ton of silage*
10—15	80—100 gallons
16—20	20— 50 ,,
25 plus	Virtually nil

Taking the worst possible situation, with grass of 10—15 per cent dry matter, then a 300-ton clamp will produce about 30,000 gallons of effluent, and most of this will be discharged during the first 10—14 days after ensiling.

Where clamps are made on a temporary site they should be built well away from ditches and watercourses and left to stay as a thin layer on the soil surface around the clamp, where it will dry and decompose naturally.

At a fixed site silage clamp, the effluent should be collected in open channels, preferably half-round glazed, which can easily be brushed clean and drained to a sump. The sump should be well constructed, with a concrete base and sides of concrete rings, made water-proof with bitumen.

The sump should be emptied daily by vacuum tanker and the contents spread back on grassland. To reduce scorch, the effluent should be diluted with water in equal parts.

Problems arising from silage effluent pollution are increasing every year and farmers are urged to take every precaution to minimize the danger.

Further information is contained in Short-Term Leaflets No. 67, *Farm Waste Disposal*, and No. 87, *Silage Effluent*, and in Advisory Leaflet No. 482, *Ensiling Grass*. Single copies of these leaflets can be obtained, free, from the Ministry (Publications), Tolcarne Drive, Pinner, Middlesex, HA5 2DT, or from any of the Ministry's Divisional Offices.

Where natural drainage is limited, it can be improved artificially by

Drainage on Weald Clay

W. Addison

WEALD Clay straddles south-east England like the print of some giant horseshoe, with its twin heels at Hythe and Eastbourne and its toe encroaching upon Hampshire's border with Sussex. Its outcrop encircles the complex of formations collectively known as the Hastings Beds and it is, itself, encompassed by the successive bands of the Upper and Lower Greensands, the Gault and the Chalk.

The area described in geological terms as Weald Clay in fact comprises a variety of sedimentary rock formations, including sandstones, clays, limestones, shales and so on, and the effects of weathering have produced a wide range of soils of which the clays predominate.

Increasing value and diminishing availability of agricultural land in the south-east have together contributed to a departure from the more traditional systems of farming on Weald Clay. Enterprises vary, from extensive grassland, cereals and dairying to top fruit, soft fruit and other forms of intensive cultivation.

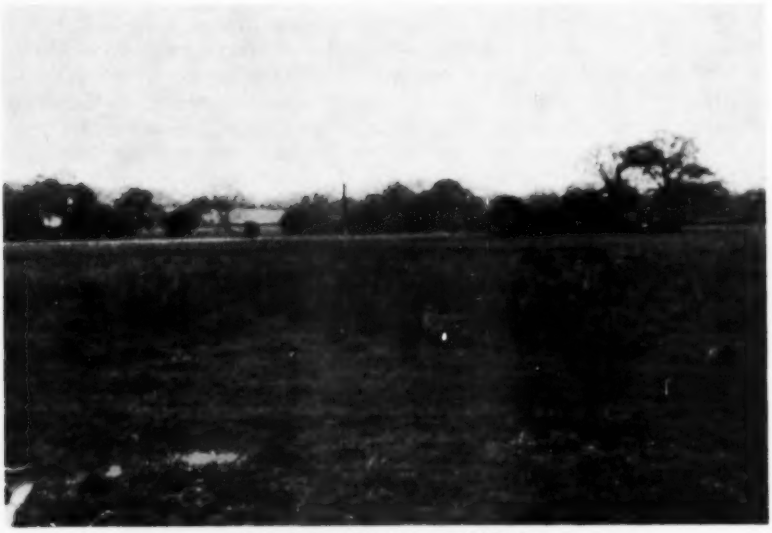
Generally, natural drainage in Weald Clay is extremely limited and good farming can rarely be practised without the help of some form of artificial land drainage. Against this background of variable soils and divergent enterprises it is hardly surprising that no single accepted standard system of land drainage has emerged which can be universally applied.

Drainage problems

Drainage problems on Weald Clay arise through varying combinations of site and circumstance, any single specific cause being difficult to identify. They represent part of the price we must be prepared to pay in reparation for the greater demands we make on our soils.

Weald Clay is generally stable and will, under normal treatment, maintain some structure in the subsoil to a depth of about thirty inches. Below this depth, the clay is massive and unlikely to show any signs of fissuring, even at the end of prolonged dry periods. Hence, although water can move downwards and, to a lesser extent, laterally through the profile to this depth, complete seasonal saturation is common, particularly on flatter sites. Although a water table is never clearly defined, this condition in the subsoil helps accelerate the breakdown of structure associated with ill-timed cultivations and poaching by livestock.

Thus a typical problem of so many areas of the Weald is a combination of surface ponding and high water table. In these circumstances, severe compaction is usually evident to a depth of some 12-15 inches. Structure in the subsoil beneath this zone is often found to be unimpaired and, significantly, it frequently remains fairly dry even in winter and early spring. In extreme conditions, absence of soil structure may be complete throughout the profile.



An undrained flat site on Weald Clay

Drainage systems

The general low level of permeability in areas of Weald Clay places a restriction on the proportion of open ditches which can safely be eliminated. Whilst summer and autumn run-off can be deceptively low, the intensity increases during the winter after field capacity is reached. Although the need to reduce ditch maintenance is pressing, experience has shown that some ditches must be retained to carry away this surface water quickly and effectively. The open ditch is therefore a regular feature of the landscape and acts as the ultimate outfall for the majority of field drainage systems. Beyond this point, however, there opens up a somewhat bewildering picture of drainage systems, varying in almost every basic aspect of design. The closest approach to a common factor is probably that of the depth of lateral drains, which lies fairly consistently between the limits of 30-36 inches. This clearly represents the depth at which natural or induced permeability normally ceases and below which no crack development is likely.

At first sight it would appear that a wide choice of effective drainage designs is available to the farmer on Weald Clay at an equally wide range of costs. In practice, certain unavoidable constraints are placed upon him.

He can, within certain limits, decide upon the crops he will grow, the level of any risks he is prepared to take and the amount of money he is willing to spend. To this extent he can exercise virtual freedom of choice. But the design of the most economic and effective drainage system, whilst irrevocably linked to the particular farming enterprise and tailored to meet its requirements, will be influenced by factors which lie largely outside his control.

Orchards and other forms of intensive growing fall into a special category for which high cost drainage can readily be justified. Under these circumstances, the provision of a drainage system tends to be somewhat divorced from normal design criteria. When capital investment is high, it is not unreasonable to provide maximum insurance. A special problem is created in fruit growing areas where frost protection by spraying is practised. An application of one inch of water during a night is not unusual. To minimize the risk of severe structural damage and to recover as large a proportion as possible of the irrigation water, schemes of high intensity are frequently installed. Provision is usually made for secondary treatment in the shape of moling or subsoiling as a permeability aid.

The need for some form of secondary treatment is in fact now accepted in the majority of situations on Weald Clay. Site and soil conditions largely determine whether moling or subsoiling provides the means.

Soil profile, showing compacted zone and underlying well structured zone

Soil samples from same profile pit
Right: surface layer. Left: underlying layer

Mole drainage

Tradition may play some part in determining the location and extent of the areas in which mole drainage is a commonplace practice, but the existence of suitable conditions has probably a far greater influence. The longer the life of the mole channel, the more economically attractive the system becomes. Maximum durability can be expected in those areas where the clay has a well developed structure and does not contain overlarge proportions of silt or sand. Such areas, however, are not readily capable of identification by any superficial examination and their incidence is largely irregular. In addition to the hazards created by possible soil instability and extremes of gradient, further complications in Weald Clay are the random deposits of ironstone and the somewhat formidable areas of Paludina limestone or 'marble'.

Ironstone is by no means uncommon. It can be found in continuous bands of differing thicknesses or in the form of nodules lying in isolation or in groups of varying concentration. It is largely the depth at which these deposits occur which dictates whether or not successful moling can be carried out. Provided that the zone between 18 and 24 inches remains free of obstruction, the presence of disturbed ironstone in a moled area is probably an aid to soil permeability rather than an obstacle.

Paludina limestone, known locally in many areas as 'winkle stone', is the legacy left by deposits of freshwater snails some hundred million years ago. This stone, found in slabs or continuous bands of thicknesses up to several inches, can itself be the cause of drainage impedence. The depth at which it occurs is usually irregular, and when shattered by moling it is likely to cause a fairly severe disruption of the subsoil. Mole drainage under such conditions

is something of a gamble. The element of uncertainty can be largely eliminated by substituting subsoiling for moling under less than ideal conditions and this is indeed becoming a more common practice on Weald Clay.

Subsoiling

It is doubtful if any area exists, on Weald Clay, where subsoiling can be safely carried out other than over an effective underdrainage system. The underlying impermeable subsoil prevents further downward movement of water; subsoiling, without the existence or provision of underdrainage, creates a vast mass of disturbed and saturated soils and a consequent further deterioration of soil structure.

Underdrainage, when accompanied by subsoiling, comes in many guises. Design is influenced as much by what is to be expected of the land as by existing soil conditions. This is probably never more true than when applied to the use or omission of permeable backfilling material, such as stone chips or gravel, over the pipe.

Permeable backfill

Where intensive use of land is anticipated, whether by cropping or by high stocking rates, it is often necessary to carry out moling or subsoiling to create or maintain soil permeability. In such cases a permeable backfill must be included to form a connection with the pipe drain system. Experience has shown that this will permit repeated subsoiling without the progressive deterioration in permeability that might otherwise occur. The depth of filling material is varied to suit individual site conditions, particular regard being paid to the depth at which a stable structure and significant crack development exists. Filling materials are becoming steadily more expensive and account for almost half the cost of many schemes. It is therefore not surprising to find that many farmers have adopted a more critical approach to drainage design; and that there exists a greater awareness of the necessity to justify all refinements economically in terms of improved performance.

Straw is used as a backfilling material in soils where the fine sand and silt content is high to act as a filter.

Plastic pipes

The use of plastic piping has been steadily increasing over the last two or three years. In some situations it has been possible to make a direct substitution without alteration to scheme design. However, as the tendency is to use pipes of significantly smaller diameters for reasons of economy, the layout of many schemes has required modification to compensate for lower carrying capacities. Particularly affected are the wider spaced systems relying upon subsoiling and those involving mole drainage with its intense and flashy discharges. Installing pipe by the 'trenchless' method is attracting increased attention, largely because of the savings which can be made in the quantities of the permeable fill used.

The introduction of this comparatively new material and operational technique has added yet one further dimension to the tableau of drainage on Weald Clay.

Typical systems and costs

System	Interval between drains feet	Permeable fill depth over pipe inches	Gross Cost per acre £
Plastic pipe and Subsoil	15	6	400
Tile	12	12	336
Tile and Subsoil	50	12	99
	66	12	88
	66	6	80
	90	12	77
Tile with straw backfill and Subsoil	66	—	51
Tile and Subsoil	50	—	68
Plastic pipe and Subsoil	50	6	86
	66	12	80
	66	6	69
	90	6	66
Tile and Mole drain	130	12	61
	165	12	54

Yet, despite all the available alternatives, there is no panacea for the drainage ills of Weald Clay. There is no substitute for good husbandry and a healthy respect for the soil.

W. Addison, M.I.Agr.E., is the Ministry's Divisional Drainage and Water Supply Officer at Guildford.

Be Safe with Electric Fencing

The increased use of controlled grazing methods in recent years has led to a greater use of electric fencing on our farms. This, in turn, has introduced hazards for the unwary or inexperienced, and deaths have occurred as a result of the mishandling of this type of fencing.

Great care must be taken when electric or other wire fencing is being erected or moved under or near overhead power supply lines, particularly on undulating ground. Any 'whipping' or upward movement by the wire may take it dangerously close to, or bring it into contact with, the supply line; when erecting a fence in such circumstances it must first be anchored securely under the power line.

Whenever possible an electric wire fence should be erected at right angles to any supply route. Where this is not it should on no account be routed parallel to and within 30 ft of the ground immediately below the line; if erected nearer than this current can be induced into the wire fence, possibly with serious results.

Where the practice is to re-charge the battery of a battery-operated unit by using a mains charger, the battery must first be disconnected from the fence unit and remain disconnected during the charging operations. Mains-operated equipment for electric fencing should be installed only by a qualified electrician. Battery-operated fencing equipment should *never* be connected to a mains supply.

Any earth electrodes connected to the earth terminal of an electric fence controller must be separate from the earthing system of any other circuit, and not more than one controller should be connected to any electric fence or similar system of conductor. Every mains-operated fence controller should be so installed that it is safeguarded from mechanical damage or unauthorized interference. Home-made controllers should never be used; they have often caused death, injury, fire and loss of livestock.

A final and important point to remember is that an electric fence erected near public rights of way should be fitted with appropriate warning notices.

Beef Production in Italy

A. J. Chalmers

FEW people associate beef production with Italy, but over the past decade the consumption of beef per head of population in that country has almost doubled. A comparison of consumption figures for Italy and Britain is shown in Table 1.

Table 1

Meat consumption in Italy and Britain, 1970

	(Kilogrammes/head) Italy	Britain
Bovine meat	23·8	21·2
Pig meat	10·5	21·0
Sheep and goat meat	1·0	9·6
Poultry	11·0	10·5
	46·3	62·3

Increased prosperity in northern Italy has resulted in a greater demand for beef and the supply from traditional forage type feeding on small farms has proved grossly inadequate. The Italian Government, being aware of this, has had two five-year plans, known as 'Green Plans', which provided for the improvement of farming, the encouragement of more beef production and for the general welfare of Italian farmers. Small farmers are encouraged to form viable groups which can take advantage of long term loans at low interest rates. The impact so far has been quite considerable and the Government is now embarking on a third five-year plan.

In spite of these incentives, however, the production of beef in Italy cannot meet the demand and there is still a large net trade deficit bigger than in any other member country of the E.E.C. The production figure for beef and veal in 1969 was 779,000 tons carcase weight, giving a net deficit of 450,000 tons. Estimated figures for 1973 and 1975, respectively, are for production of 825,000 and 835,000 tons with deficits of 495,000 and 525,000 tons.

The 'Green Plans'

During the first 'Green Plan' in the early 1960s, a swing towards large scale beef production took place. Several commercial beef lots were established, financed by Government loans and investment from the trade and industry. The buildings used were generally elaborate and the cattle purchased from East European countries. Feeding was based mainly on cereals.

During the second 'Green Plan' in the late 1960s, a change from intensive cereal feeding to production methods based on maize silage took place, more

like those operating in the United States. A number of very large beef lots, usually exceeding 1,000 cattle, were established in the Po Valley, with modern layouts to facilitate the latest feeding and management systems. To meet the demand for beef calves and young stores most are imported, mainly from Switzerland, Poland, Yugoslavia, Hungary, Belgium, Germany and France. Some have been imported from other sources such as Britain, Ireland and Canada. Home production of calves has decreased while imports have increased steadily (Table 2). Imported stock accounted for half the slaughterings in 1970.

Table 2

Number of cattle imported into Italy, 1967-1971

1967	1,301,316
1968	1,675,628
1969	1,956,000
1970	2,100,000
1971 (first 6 months only)	1,129,000

Cattle types

Two basic types of cattle are used in Italy. They are the Simmental, which accounts for approximately 50 per cent of the total, and the Friesian, accounting for 30 per cent. The remaining 20 per cent of others includes Brown Swiss, Limousin and cross breeds.

Simmental Cattle in open yards during the growing stage

Management

The systems of management are relatively simple, with the animal's life divided into three periods of four months of rearing, growing and fattening.

Rearing. The rearing stage commences when the calves arrive on the farm. Their feeding regime and weaning procedure is similar to that practised in Britain, with weaning taking place approximately forty-five days after arrival. Few health problems seem to be encountered, although some respiratory disorders occur. Calf mortality was quoted as being between 2 and 3 per cent. At 120 days of age, when the calves are about 150 kilogrammes liveweight, they are introduced to forage in the form of maize silage. Rigid culling generally takes place during this period and some 5 per cent of the animals are culled for veal production.

Growing. This stage takes the cattle from 150 kilogrammes to 300 kilogrammes liveweight. The ration during this stage is fed to appetite and consists of maize silage with some concentrates. The concentrate ration would be based on maize or barley, with a protein supplement, typified by the examples shown in Table 3.

Table 3

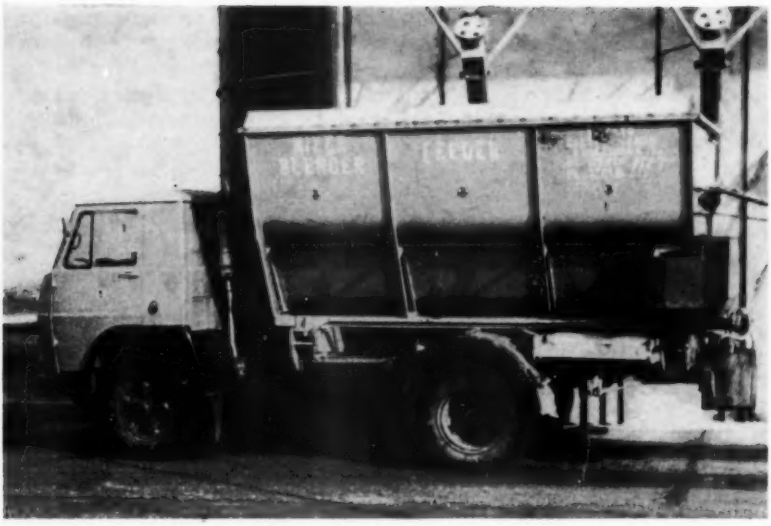
Concentrate rations fed with maize silage

	Example 1 %	Example 2 %	Example 3 %
Maize	70	58	80
Barley	15	20	
Soya + minerals + vitamins	15	3	
Lucerne meal		19	20
	100	100	100

Fattening. For the fattening stage there are two basic systems of feeding, *ad lib*. maize silage with high concentrates and restricted silage with concentrates. Cattle fed on the *ad lib*. feeding regime finish slightly earlier than those on a restricted diet. For the *ad lib*. diet, the daily intake per head is generally about 5–6 kilogrammes of concentrates with anything up to 15 kilogrammes of maize silage. Where restricted feeding is practised, the maize silage is fed at about 12 kilogrammes per head per day, plus 3–4 kilogrammes of maize and barley concentrates. Cattle are slaughtered when they reach the necessary degree of finish at about 400–500 kilogrammes liveweight. They are seldom moved and weighing takes place only as the animals are withdrawn for slaughter when a pen is emptied.

Marketing

As in Britain, there are three main marketing outlets, the open market, wholesale meat dealers (who could be owners of a beef lot) and through dealers in live animals. Most of the larger beef units sell directly to wholesalers, the normal practice being for the wholesaler's agent to visit the feed lots weekly and mark all suitable cattle for the following week's slaughtering.



Feed delivery lorry for both concentrates and maize silage

Health

The incidence of disease in the calf units is low, probably due to the strong calf at purchase (usually about 50 kilogrammes liveweight minimum) and the degree of pre-selection prior to purchase. Foot problems appear occasionally amongst calves on slats, particularly where the slats are of an inferior type. In the growing and fattening units the health of the cattle is good, no doubt helped by the considerable movement of air experienced in the Po Valley where most of the units are situated.

Housing

Calves are reared on slats or in groups on straw on individual farms. Individual penning on slats is similar to that practised in new units in Britain with little or no straw. After weaning, the calves are housed in groups of about twenty, either on slatted floors or on litter. They are kept in this accommodation for four months, when they are transferred to growing yards. The housing is normally in old converted farm buildings typical of many units in Britain.

During the growing stage, housing varies from cheap open yards to the more expensive slatted buildings. The open yards are simple, of wooden construction with a covered area for feeding and a covered lying-back area for shade. The fencing and shade area are very much a do-it-yourself job and the young bulls, being extremely docile, are easily contained within this area. These yards work extremely well in the summer months and the cattle are healthy and thrive. However, in the colder wetter months the open

yards are not so satisfactory. Some units have only a sacrifice area with a small amount of shade over the trough. During the extremely hot months this shelter is not enough, resulting in depressed liveweight gain. The stocking density in the slatted units is fairly intense, at about 20 sq. ft per beast.

Fattening houses are basically of two designs. They may be either individual ties or loose housing on slats. A few feed lots have animals tied up on each side of a central feed passage. Loose housing generally consists of two rows of pens on either side of a central feed passage which is wide enough to allow a self-unloading forage box to deliver feed into the troughs. The buildings are high and ventilation is most critical during hot weather; they are at least 13–14 ft to eaves height and 20ft to an open ridge. The gap immediately below the eaves is some 6ft in depth; it is kept open during the summer months and can be closed in winter. Air enters the buildings over the backs of the cattle and leaves through the open ridge. In the installation of new buildings there is a distinct emphasis on cubic feet per head rather than square feet per animal.

Slurry is pumped into lagoons twice a week, with the lagoons being emptied once during the summer and twice during the winter. The machinery, like the buildings, is new and expensive, with numerous tower silos, although very few are coupled to mechanical feeders. The trend is now towards clamp silos for both silage and grain, with the grain ground before being stored. Feed mixers, self-unloading side delivery forage boxes, machines to remove the silage from the clamps and slurry tankers are standard equipment on most units.

Conclusion

The success of beef production in Italy is largely dependant on the production and use of maize and the Po Valley is ideally suited to the intensive growing of the crop.

The problem of obtaining calves is now a major consideration with some of the larger operators already experiencing difficulty in getting enough. It is essential for full capacity to be maintained in these expensive beef fattening units and it seems likely that some of the beef lot operators are already looking to Britain for calves.

The standard of stockmanship of the Italian farmer is high and equally as good as in this country. In some ways he is fortunate, however, not to have the same complications of grazing and pasture management.

A. J. Chalmers, N.D.A., S.D.A., is a Livestock Husbandry Advisory Officer serving with A.D.A.S. at the Area Office, Sleaford, Lincs.

Central Council for Agricultural and Horticultural Co-operation Fifth Annual Report

The Fifth Annual Report of the Central Council for Agricultural and Horticultural Co-operation has been published. The Report covers the year 1st April, 1971 to 31st March, 1972, and deals with the Council's administration of the Agricultural and Horticultural Co-operation Scheme 1971 and with their activities in the promotion and development of co-operation.

Copies may be obtained from the Council at Hancock House, Vincent Square, London, SW1P 2PQ (Telephone: 01-834 1741).

A lake on the estate farmed by the damming of a stream

Conservation: An Estate Walk in Surrey

J. Lewington, *Lands Arm, A.D.A.S., Guildford*

In May 1972 an Estate Walk was held in Surrey to demonstrate the understanding that can be developed between the various users of the countryside and to consider the reconciliation of farming, forestry, water supply, wild life, landscape and public access.

The walk was organized by A.D.A.S. Guildford in conjunction with the Country Landowners Association and the National Farmers' Union. By kind permission of the owner, Mr. R. E. Thornton, we met on the Hampton Estate, near Farnham. About 150 attended, including landowners, farmers, surveyors, local planning officers and representatives of amenity societies, which provided a good cross section of users of the countryside.

During the walk stops were made at which short talks were given by the owner, by representatives of the Surrey County Council, the Thames Con-

servancy, the Forestry Commission and the Nature Conservancy and by the Agriculture, Lands and Veterinary arms of A.D.A.S.

The Estate and farming

The Estate is on light sandy land and extends to 2,600 acres. This includes 1,650 acres of farmland, 750 of woodland and 450 of common land. The park was laid out in the eighteenth century with lakes and woodland. The farmland is farmed by the owner and there are 470 dairy and beef cattle and 650 acres of arable land. The relationship of soil type to farming and its effect on the landscape was discussed, and it was thought that a good balance of arable, grass and woodland has been achieved. The landscape cannot remain unchanged but it can be managed for farming without overlooking the needs of conservation and public access.

Farm buildings

The farm buildings are mainly traditional in character; they are well sited in a fold in the ground and are screened by mature trees, and the natural materials used harmonize well with the landscape. It was noted that the roofs were darker than the walls, which helped them fit into the landscape. The buildings have been altered a number of times with the changing needs of farming but appearance and amenity have not been overlooked.

Disease hazards

The hazards caused to animal health by access to farms were described. Access means that the isolation of a farm from disease can be destroyed and infection brought on to a farm both by other farmers and by members of the public. Hired or borrowed equipment and rubbish dumping can be sources of infection.

Forestry and wild life

The 750 acres of woodland are protected by a Dedication covenant into which the owners have entered with the Forestry Commission. The landscape has been much changed by recent planting, some 450 acres of plantations being less than 25 years old. In planning the regeneration of the woodlands, amenity and the effect on the landscape have been considered. The margins of plantations have been planned in relation to the topography and different species have been used for their distinctive form and colour.

The importance was stressed of providing a diversity of habitats for the conservation of wild life, both plants and animals. The woodland on the estate includes recent plantations of conifers and hardwoods as well as old oak woodland and coppice. There are valuable wet habitats around the lakes and further variety is provided by the mixed farming practised.

Commons management

Puttenham Common, owned by the estate and managed by Surrey County Council under an Access Agreement, attracts about 50,000 visitors a year and the number is increasing. To try to overcome the problem of erosion, the grass car parks have been divided into areas which are used and rested in rotation. Hydraulic reseeding has been tried on the worst eroded areas. Severe erosion has also occurred on the banks of the lake.

As far as possible the conflicting interests of walkers, horse riders and wild life conservation are reconciled. Concentration of public access on to the common has the advantage that farming, forestry and wild life on the rest of the estate are to a great extent left undisturbed.

Fishing and pollution

The fishing on the lake adjoining the common is let to a local angling society and good catches are reported. The work of the Thames Conservancy's Inspectors was described during the walk and the dangers of pollution from silage effluent and crop sprays were pointed out.

Results

At the end of the day there was a concluding discussion at which all the speakers were present. There was a growing demand for public access and recreation, including picnic areas, nature trails and footpaths.

The danger of spreading animal disease was recognized but it was felt that this could be avoided by concentrating public access on to chosen areas of the farm.

The design of new large farm buildings was discussed and it was suggested that these could be made to harmonize with the landscape by careful choice of site, materials and colour.

This estate walk was essentially a practical demonstration involving local people and local officials. Many contacts were made between people with different interests in the countryside and many said that they had found this most valuable.

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Diseases of Animals (Miscellaneous Fees) Order 1972

Under the above order from 1st July 1972, increased fees became payable for services in respect of

(*a*) the veterinary examination at ports of animals imported from the Channel Islands, the Isle of Man, Northern Ireland, the Irish Republic and Canada;

(*b*) the importation and quarantine of animals from certain other countries;

(*c*) imports of poultry and hatching eggs into Great Britain and the movement of poultry and hatching eggs into Scotland from any other part of Great Britain;

(*d*) the testing of disinfectants;

(*e*) the reception and isolation of animals in export quarantine stations provided by the Minister or Secretary of State.

Fees for these services (except those for the testing of disinfectants) have remained unchanged since 1963/64 and the increases have been made so that the full economic cost of the services can be recovered.

The Order also prescribes fees, for the first time, for business transacted with respect to the landing in Great Britain of ruminating animals and swine intended for exhibition.

The Diseases of Animals (Miscellaneous Fees) Order 1972 (S.I. 1972 No. 863) consolidates with amendments the Diseases of Animals (Miscellaneous Fees) Order 1964 and the Diseases of Animals (Miscellaneous Fees) Order 1970. Copies may be obtained from H.M. Stationery Office, price 8p (by post 10½p).

Farming Cameo: Series 5

11. Cornwall

G. H. Hughes

THE county of Cornwall is a peninsula some 115 miles in length, with a maximum width of 40 miles at the boundary with Devon and tapering to a point at Lands End. Most of the land is below the 400 ft contour, although isolated tors on Bodmin Moor rise to 1,400 ft. The rivers are, in the main, short and steep, there being no flood plains but numerous tidal estuaries with steep wooded banks.

Soils and climate

The soils are of three types:

1. Poor, exposed, granite uplands, with impeded drainage and high acidity, running the length of the county from east to west.
2. 'Shillet', a free draining loam of the Devonian series, ideally suited to crops or grass.
3. The culm soils of the carboniferous measures, a heavy clay with a high silt content and difficult to manage during the winter months.

The temperate climate with freedom from frosts and a long growing period is ideal for grass growth, but creates problems in the production of high quality hay and silage. The absence of 'winter kill' makes the county a plant pathologist's paradise and fungus diseases are prevalent amongst all the arable crops.

Production

Under prevailing conditions it is inevitable that milk should be the county's main product, with a growing emphasis on beef from the dairy herd as a by-product. Sheep form a major enterprise in the northern area of the county, where buildings are scarce and out-wintering a problem. Over many years, the advisory services have demonstrated the relationship between fertilizer usage, stocking rate and grass output; and the rising level of livestock production is undoubtedly due to denser stocking and improved management.

Cereal production, 120,000 acres, is intended entirely for consumption on the farm and is part of the mixed farming system common throughout the county. Both yield and quality of grain are disappointing in the majority of seasons, and it is the lack of capital and suitable labour that prevents many of the larger holdings concentrating on the more productive livestock enterprises.

The soil and climatic conditions in limited areas of east and west Cornwall are ideally suited to the production of bulbs and flowers, broccoli, early potatoes and spring cabbage, with some soft fruit in the Tamar Valley. The

success of these crops is largely dependent upon the weather and prices in the free market, and is becoming more of a gamble each season.

In common with all other sections of the industry, road and rail transport to market is an ever-increasing problem, both in cost and availability. With a distance of over 300 miles to the main industrial centres, areas of the Common Market countries may be better placed than the Cornish producer to meet U.K. needs.

Farm structure and equipment

The large number of small family farms continue to make an acceptable living by milk production, mainly from grass, with a minimum of hired labour and low capital investment in fixed equipment. The Farm Improvement Scheme, and more recently the Farm Capital Grant Scheme, has led to some marked improvement in recent years.

Electricity and piped water supply now cover the entire county, and Dutch barns and covered accommodation for livestock are increasingly common; modernization of dairy premises proceeds with the installation of milking parlours or pipeline milking in existing buildings and the provision of bulk tank milk facilities.

In the absence of suitable alternative employment within the county, the amalgamation of farms into larger units makes slow progress. Quite apart from the desire to remain self-employed, there exists an increasing demand for amenity holdings, where people not normally engaged in the industry can live. With 56 per cent of the total acreage in owner occupation, it seems unlikely that the small farmer problem in the county will be easily overcome.

Tourism

With increasing emphasis being placed on the leisure industry, tourism is becoming of much greater importance and is, in fact, the major industry in the county. Farmers and their local organizations are shy in discussing the matter, not taking an active part in promoting the development of tourism on the farm as an alternative use of land, labour and capital. Evidence already exists that pony trekking and a nine hole golf course are better economic use of eligible hill land than keeping hill cows—even with a subsidy.

The University of Exeter is now in the final stages of a two-year study of individual farm units to establish levels of investment and return on the capital involved in tourism on farms; and the County Council are running courses of instruction on day-to-day organization of such units. With 360 miles of coastline, large areas of which are controlled by the National Trust, there is ample opportunity to meet existing demands by providing good quality accommodation for holiday makers who have come to the end of the motorway!

Outlook

In common with other parts of the country, the agricultural industry in Cornwall has its problems, many of them longstanding. Within the limits of opportunity, producers continue to achieve an acceptable standard of living, making use of family labour, and feel that they are capable of competing with the larger farms in other parts of the country in livestock production.

in brief

- **Wild oats and the W.R.O.**
- **Single cell protein**

Wild oats and the W.R.O.

THE trouble with wild oats is the insidious nature of their infestation. Hitherto clean fields begin to show vanguard plants here and there and unless rogued immediately they multiply seemingly with the speed of light. The past five years have seen this ubiquitous weed increase from a nuisance to a menace, losing cereal farmers, at an estimate, something approaching half a million tons of grain a year. The explosive nature of its spread during that time must certainly be laid at the door of successive corn growing, together with the use of contaminated seed and the dissemination of wild oat seed from field to field by combines and from one part of the country to another by its presence in straw. A recent joint survey by the Weed Research Organisation and A.D.A.S., in collaboration with several other organizations, showed the amount of wild oat seed in farmers' seed drills at sowing time in England and Wales to be 11 per cent of the samples of seed supplied by merchants and 41 per cent of those from seed coming from the same or another farm. But inasmuch as seed merchants and growers are becoming more conscious of the wild oat problem, they are paying greater attention to their sources of supply. Commenting in this year's report of the Weed Research Organisation* on the spread of wild oat seed by straw, J. Holroyd remarks that if the straw from fields containing wild oats were to be burned rather than baled, it is likely that the further spread of the weed could be reduced. Packing straw, feed grain, farm machinery, straw merchants' lorries, used sacks and bags, farmyard manure, birds and vermin are all known carriers of wild oat seeds.

On the stitch-in-time principle, the value of hand-roguing and burning cannot be stressed too strongly. But this is necessarily a slow business and can be uneconomical of labour. Therefore a speedier process, using a special herbicide application glove developed by the Herbicide Evaluation Section of the W.R.O., is likely to prove a much better control of an incipient invasion of wild oats, particularly where a cereal is being grown for seed. With this glove, the operator can apply controlled amounts of herbicide through an absorbent pad in the palm to panicles of individual wild oats. Patented through the National Research and Development Council, limited numbers of this glove will be available commercially this year.

Apart from precautionary cultural practice, the control of infestations on a greater scale has hitherto depended on two herbicides—tri-allate and barban. The normal emulsion formulation of tri-allate has the disadvantage that it needs the right soil conditions to be effective. The research on a *granular* formulation by the W.R.O., as discussed in its current report, and subsequent commercial development, has placed a more formidable weapon in the hands of cereal growers. 'The granular formulation', it is claimed, 'has almost the same level of activity as the liquid but does not need to be mixed with the soil. In addition it can be used either pre- or early post-emergence, thus extending considerably the time during which it can be utilized effectively'. But special application equipment is necessary.

*The 4th Report (1969-71) of the W.R.O. can be obtained from Begbroke Hill, Sandy Lane, Yarnton, Oxford price 48p.

W.R.O. experimental work in the control of wild oats has included the use of two other post-emergence herbicides, both available in the U.K. for the first time this year—chlorfenprop-methyl and benzoylprop-ethyl. The former, says the report, has advantages over barban in that all varieties of wheat and barley appear to be equally resistant and wild oats are susceptible up to the 3-4 leaf stage. One minor drawback, which applies equally to benzoylprop-ethyl, is that the manufacturers suggest a minimum volume rate of 25 gal/ac for maximum effectiveness.

Single cell protein

SCIENTIFIC research over the past few years to meet an escalating world demand for more protein is now pointing very firmly to the value of microbial proteins as an innovation in animal feedingstuffs. A large-scale commercial achievement in this area would automatically release a considreable amount of the world's crop production for human consumption, so that the current work proceeding in Britain and overseas is such as to command a literally vital interest. Although the growth of micro-organisms, such as certain bacteria, yeasts and other fungi, on hydrocarbons, e.g., oil and natural gas, has been well known for many years, not until relatively recently has the idea of their deliberate cultivation on a large scale found expression as a commercial concept.

W. R. Holmes, writing in the Journal of the R.A.S.E.,* referred to the gathering strength in this field of research citing, among other oil companies here and abroad, British Petroleum. That company has a pilot plant at Grangemouth growing yeast on n-paraffin 'now ready to supply 4,000 tons per annum of a material containing 63-65 per cent crude protein'. Rank, Hovis and McDougall are working with fungi grown on starch to produce a substance containing 45 per cent protein of very high nutritional quality. In the U.S.A., a 61 per cent protein from natural gas is expected to be a viable commercial product by 1975; and in Switzerland, Esso-Nestlé have produced a bacterial protein of 62-73 per cent from refined paraffin.

The latest entrant into this exciting and promising field is Imperial Chemical Industries, whose pilot plant at Billingham, designed to make 500–1,000 tons of the product annually, is expected to be completed early next year. Here the product will be obtained by growing under carefully controlled, aseptic conditions a newly isolated bacterial strain which assimilates methanol deriving from either naphtha or natural gas as its feedstock. It will contain 75 per cent crude protein and will provide, it is suggested, a good source of protein for young chicks and broilers. It is claimed that methanol has several advantages over hydrocarbons as the feedstock for a protein plant, notably being completely soluble in water and readily obtained in a highly pure form.

Non-ruminants, such as pigs and poultry, need a high quality protein diet. It is therefore as a supplementary source of the supply of such protein that single cell protein will be used, at least initially. The rapid multiplication of these simple organisms in a controlled environment is an extension of the new farming technology which, in the first place, livestock farmers will watch with interest and, in the second, the world's hungry millions will view with hope.

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Books

Irish Agriculture in a Changing World. Edited by I. F. Baillie and S. J. Sheehy. Oliver and Boyd, 1971. £2·50.

Thirteen papers were given in Dublin in 1968 at a Conference sponsored by the Agricultural Adjustment Unit of Newcastle University on the theme of 'Irish Agriculture in a Changing World'. They describe the general nature of agricultural change in relation to economic development; the trends in Irish agriculture up to 1967 and the formation of agricultural policy in the Republic of Ireland; the trade relationship with Britain—'virtually a Common Market' were the words used by H. G. Foster of the Irish Embassy, London—and the objectives of agricultural research, education and extension.

The domestic market of the Irish Republic was examined by Rosemary Fennell who noted its small size, slow growth rate but high level of consumption, an absence of contract farming and the need for quality control and marketing development in general. S. J. Sheehy's appraisal of the prospects of Irish Agriculture in an enlarged E.E.C. as seen three years ago is still basically relevant. Compared with the rest of the farming population, in the Western Counties 'a very large group of subsistence farmers live and work in an entirely different milieu' and J. J. Scully related the problems of agricultural adjustment to those of providing employment outside farming.

A concluding paper by E. A. Attwood projected the likely magnitudes of Irish agricultural changes up to 1975 and pointed to the 'very considerable difficulty in providing help to overcome short term and essentially social problems of the rural community without conflicting with the long term needs of a variable and competitive industry'. In a brief summing up, S. J. Rogers felt that some sense of pessimism had settled on the Conference. This might have been easier to dispel in 1971 with a more immediate prospect of Ireland's entry into an enlarged E.E.C. and agricultural surpluses in Europe no longer presenting an intractable problem.

H.J.S.

Crop Production: Cereals and Legumes. B. F. Bland. Academic Press, 1971. £5.

Most agricultural textbooks on crop production follow a fairly rigid pattern of presentation. This one is no exception. The history, taxonomy, cultural and economic aspects of individual crops follow in an orderly fashion throughout the book. Well presented figures and tables support many of the concepts and conclusions drawn from a wide coverage of literature relating to the production and marketing of cereals and legumes. Each chapter is appended by a comprehensive list of references for further reading.

The coverage allocated to Maize and Rye is not far short of that dealing with the other major cereals and it would be difficult to locate elsewhere a more up-to-date guide on the growing and utilization of fodder legumes, lucerne and sainfoin. Within crop sections some aspects, not hitherto fully probed in print, receive special attention. For instance the author delves deeply into the need, means and effectiveness of insect pollination in field beans and the sections on harvesting, conditioning and storage of individual crops are extensive providing valuable practical guidance. On the other hand there are strange omissions. There is scarcely any reference to the control of perennial grass weeds in cereals; the spread and containment of wild oats is virtually ignored except in field beans and reference to the diseases of cereals is biased heavily towards the traditional bogey of 'take all' when surely today leaf diseases are of equal if not greater significance in cereal production in many parts of the country.

At the outset the author states that there are few principles left in our fast changing agricultural industry; gone are the days of complete adherence to strict rotations, the demands of food processors are constantly changing and new ideas on crop production are launched almost day by day. It is a brave man who ventures forth to provide a guide book such as this, for students or growers, knowing that before it appears in print some sections will inevitably require revision.

R.G.H.

Pedology—A Systematic Approach to Soil Science. E. A. Fitzpatrick. Oliver and Boyd, 1971. £4.

Dr. Fitzpatrick, who is a Senior Lecturer in Soil Science at the University of Aberdeen, states that this book on pedology (the study of soils as naturally occurring phenomena) is intended for undergraduate and post-graduate students of various kinds but not for the specialist pedologist. For

reasons which will be mentioned later, however, it would seem to the reviewer that the book contains much of interest to the specialist in addition to the serious student of pedology.

The book is divided into eight principal sections which deal respectively with fundamental concepts in pedology, factors of soil formation (namely parent material, climate, living organisms, topography and time), processes in the soil system, properties of soil horizons, nomenclature and classification, soil classes of the world, a review of soil classification and the inter-relationship of soils with various factors and with each other. It is very well illustrated with excellent diagrams and keys of various kind and with photographs of more variable quality. The treatment is world-wide without undue emphasis on the soils of the British Isles. The agricultural properties of soils and soil management practices are dealt with only briefly.

The specialist pedologist will be interested mainly in the later sections in which Dr. Fitzpatrick discusses the very difficult subject of soil classification and advances a classification of his own. He draws attention to the fact—obvious enough perhaps but often ignored for the sake of simplicity—that soils do not really lend themselves to classifications of the type used for animals and plants because soils are not discrete entities in that they exhibit continuous variation and grade into each other. The alternative which is suggested by the author involves the use of standard horizons designated by symbols which can be combined together to produce formulae which can describe an infinite range of soils. Such a system would appear to have many advantages and be particularly suitable for use with data retrieval systems of various types.

W.D.

Ministry Publications

Since the list published in the July issue of *Agriculture* (p. 317) the following publications have been issued.

MAJOR PUBLICATIONS

BULLETIN

No. 94 Potatoes (Revised) 90p (by post 96½p)
(SBN 11 241394 3)

OUT OF SERIES

No. 21. Experimental Husbandry (New) 90p (by post 96½p)
(SBN 11 240791 9)

No. 23. Experimental Horticulture (New) 68p (by post 73½p)
(SBN 11 240813 3)

FIXED EQUIPMENT OF THE FARM

No. 22. Loose Housing of Dairy Cows (Revised) 31½p (by post 35p)

FREE ISSUES

ADVISORY LEAFLETS

No. 30. Caterpillars on Currants and Gooseberry (Revised)
No. 259. Leopard Moth (Revised)
No. 313. Wild Onion and Ramsons (Revised)
No. 433. Weed Control—Rushes (Revised)
No. 451. Wasps (Revised)
No. 532. Fruit Tree Tortrix Moth (Revised)

UN-NUMBERED LEAFLETS

E.E.C. Standards For Fresh Cherries (New)
Horticulture and the E.E.C. (New)

Priced publications unless otherwise stated are obtainable from Government Bookshops (Addresses on p. 368) or through any bookseller. Single copies of free items are obtainable from the Ministry of Agriculture, Fisheries and Food (Publications), Tolcarne Drive, Pinner, Middlesex HA5 2DT.

Agricultural Chemicals Approval Scheme

Fourth List of Additions to the 1972 List of Approved Products for Farmers and Growers.

NEW USES OF APPROVED PRODUCTS

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NEW PRODUCTS CONTAINING APPROVED CHEMICALS

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Amine Salts
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SIMAZINE

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Stokes Bomford

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Ministry of Agriculture Fisheries and Food

Modern Farming and the Soil

This report from the Agricultural Advisory Council describes the characteristics of the soil and how they can be recognised, the problems associated with different soil types and the treatments which can alleviate the problems. The extent to which present farming practices are having adverse effects on soil fertility and structure is discussed. There is a regional analysis which will be particularly valuable in high-lighting the areas of potential danger.

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Bacteriological Techniques for Dairy Purposes

The bulletin contains a useful historical introduction, sections giving the technical details for preparing glassware and bacteriological media and standard methods for the examination of raw and pasteurised milk, milk products and rinses and swabs of dairy equipment and farm water supplies. The appendices contain recommendations for the application of bacteriological advisory work in relation to modern methods of milk production. (Technical Bulletin No. 17)

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